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Basic Radio Propagation Predictions

FOR JANUARY 1957

Three Months in Advance

Issued October 1956

CRPL Series D

Number 146

The Central Radio Propagation Laboratory

The propagation of radio waves over long distances depends on their reflection from the ionosphere, the electrically conducting layers in the earth's upper atmosphere. The characteristics of these layers are continually changing. For regular and reliable communication, it is therefore necessary to collect and analyze ionospheric data from stations all over the world in order that predictions of usable frequencies between any two places at any hour can be made. During the war, the United States Joint Communications Board set up the Interservice Radio Propagation Laboratory at the National Bureau of Standards to centralize ionospheric work and predictions for the Armed Forces of the United States.

On May 1, 1946, this activity returned to peacetime status as the Central Radio Propagation Laboratory of the National Bureau of Standards. Designed to act as a permanent centralizing agency for propagation predictions and studies, analogous in the field of radio to the reports of the Weather Bureau in the field of meteorology, the Central Radio Propagation Laboratory was established in cooperation with the many Government agencies vitally concerned with communication and radio propagation problems. These agencies are represented on an Interdepartment Council on Radio Propagation and Standards which assists in furthering the work of the Laboratory; included are the Departments of State, Army, Navy, and Air Force, United States Information Agency, United States Coast Guard, Civil Aeronautics Administration, and Federal Communications Commission. Observers have been designated by the Air Navigation Development Board, Interdepartment Radio Advisory Committee, United States Coast and Geodetic Survey, and United States Weather Bureau. The Council works in cooperation with a Technical Advisory Committee appointed by the Institute of Radio Engineers at the request of the Director, National Bureau of Standards.

The Central Radio Propagation Laboratory receives and analyzes data from approximately 75 stations located throughout the world, including 11 domestic and 7 overseas stations which are operated either directly or under contract by the National Bureau of Standards. Ionospheric data and predictions are disseminated to the Armed Forces, commercial users, scientists, and laboratories. The basic ionospheric research of the Laboratory includes theoretical and experimental studies of maximum usable frequencies, ionospheric absorption, long-time variations of radio propagation characteristics, the effects of the sun on radio propagation, and the relation between radio disturbance and geomagnetic variation. In the microwave field, the Laboratory is investigating the relation between radio propagation and weather phenomena, as well as methods by which predictions can be made and radio communications improved in this portion of the radio-frequency spectrum. Another phase of the Laboratory's work is the development and maintenance of standards and methods of measurement of many basic electrical quantities throughout the entire frequency spectrum.

Basic Radio Propagation Predictions

The CRPL Series D, Basic Radio Propagation Predictions, is issued monthly as an aid in the determination of the best sky-wave frequencies over any path at any time of day for average conditions for the month of prediction, 3 months in advance. Charts of extraordinary-wave critical frequency for the $F2$ layer, of maximum usable frequency for a transmission distance of 4,000 km, and of percentage of time occurrence for transmission by sporadic E in excess of 15 Mc, for a distance of 2,000 km, are included.

Beginning with the January 1954 issue (CRPL-D113) the CRPL-D series, "Basic Radio Propagation Predictions," is available on a purchase basis from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., on the following terms:

Single Copy	10 cents
Annual subscription (12 issues)	$1.00
(To foreign countries, $1.25)	

The rules of the Superintendent of Documents require that remittances be made in advance either by coupons sold in sets of 20 for $1 and good until used, or by check or money order payable to the Superintendent of Documents. Currency, if used, is at sender's risk. Postage stamps, foreign money, and defaced or smooth coins are not acceptable. Remittances from foreign countries should be by international money order payable to the Superintendent of Documents or by draft on a United States bank.

Address subscriptions, remittances, and all inquiries relating thereto, to the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.

The printing of this publication has been approved by the Director of the Bureau of the Budget, July 20, 1955.
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U. S. DEPARTMENT OF COMMERCE
Sinclair Weeks, Secretary
NATIONAL BUREAU OF STANDARDS
A. V. Astin, Director

OCTOBER 1956
CRPL Series D
Number 146

BASIC RADIO PROPAGATION PREDICTIONS

FOR JANUARY 1957 — Three Months in Advance

Introduction

The CRPL-D series, "Basic Radio Propagation Predictions," issued by the National Bureau of Standards, contains contour charts of monthly median *F*2-zero-MUF and *F*2-4000-MUF for each of the three zones, W, I, and E, into which the world is divided for the purpose of taking into consideration the variation of the characteristics of the *F*2 layer with longitude (figs. 1 to 6) ; the worldwide contour chart of monthly median *E*-2000-MUF (fig. 7) ; the contour chart of median *fEs* (fig. 8) ; and the chart showing percentage of time occurrence for *Es*-2000-MUF in excess of 15 Mc (fig. 9).

Methods for using these charts are given in Circular 465 of the National Bureau of Standards, entitled "Instructions for the Use of Basic Radio Propagation Predictions," and available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 30 cents (to foreign countries, 40 cents). Requests for this manual and for the basic predictions from members of the Army, Navy, or Air Force should be sent to the proper service address as follows. *For the Army:* Office of the Chief Signal Officer, Department of the Army, Washington 25, D. C., Attention: SIGOL-2. *For the Navy:* The Director, Naval Communications. *For the Air Force:* Director of Communications, Department of the Air Force, Washington 25, D. C., Attention: AFOAP.

Following figure 9 of each issue, sets of auxiliary figures (nos. 1, 2, 11, 12 of NBS Circular 465) or forms CRPL-AF and AH are given in rotation, two in each issue of CRPL Series D. They are necessary or useful for the preparation of tables and graphs of MUF and FOT (OWF), as explained in NBS Circular 465.

The charts in this issue were constructed from data through July 1956, together with the smoothed 12-month running-average Zürich sunspot number 150, centered on January 1957.

Attention is invited to the blank form at the end of this publication, for use in reporting the accuracy of the predictions of MUF and FOT (OWF) as given in this report. Communications should be addressed to Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado. Please note this is not an address for subscriptions. These are given elsewhere in this report.

Information concerning the theory of radio-wave propagation, measurement technics, structure of the ionosphere, ionospheric variations, prediction methods, absorption, field intensity, radio noise, lowest required radiated power, and lowest useful high frequency is given in Circular 462 of the National Bureau of Standards, "Ionospheric Radio Propagation." This circular is available from the Superintendent of Documents, price $1.25 (to foreign countries, $1.65). Additional information about radio noise and a different method of presentation may be found in NBS Circular 557, "Worldwide and Radio Noise Levels Expected in the Frequency Band 10 Kilocycles to 100 Megacycles," also available from the Superintendent of Documents, price 30 cents (to foreign countries, 40 cents).

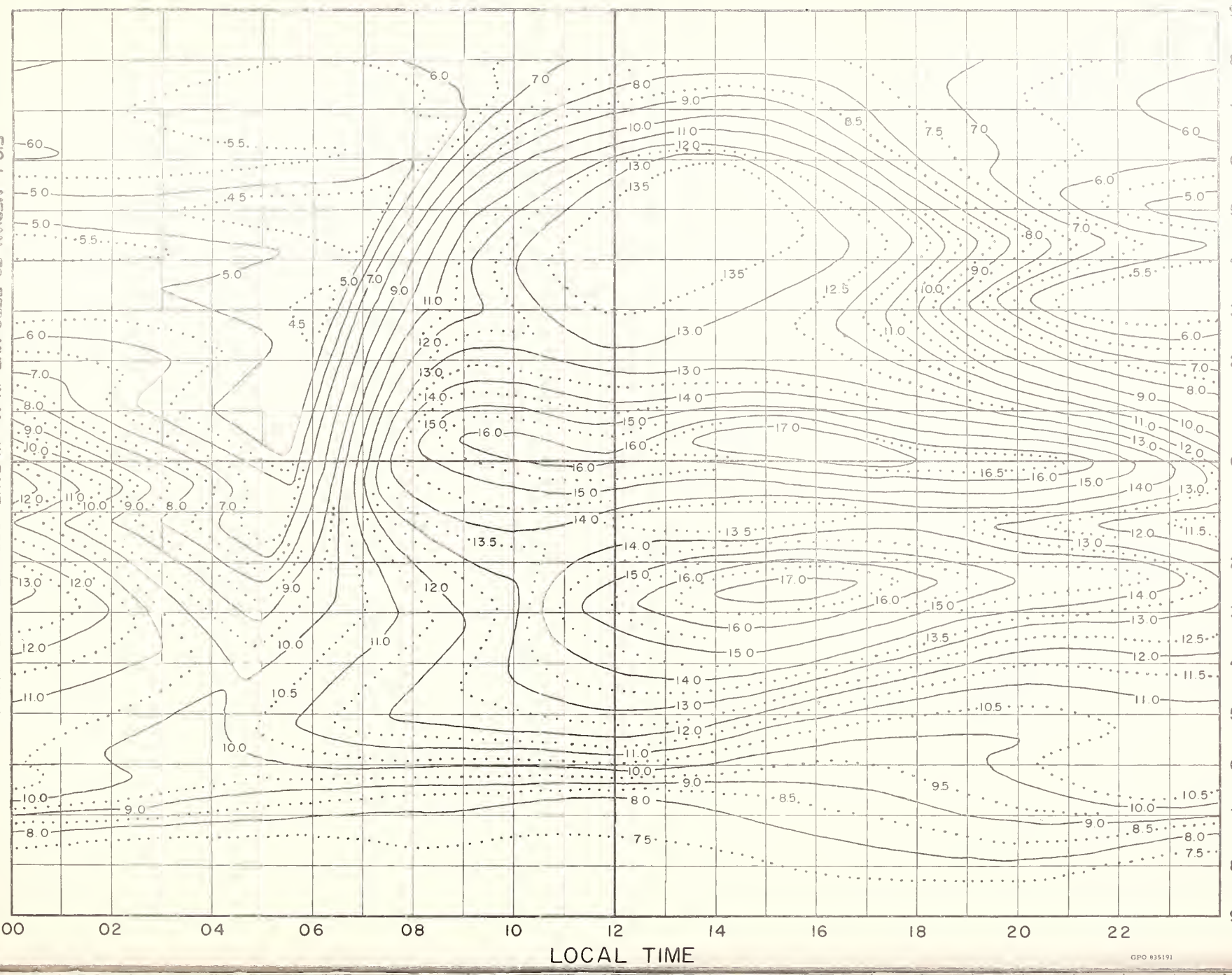


FIG. 1. MEDIAN F2-ZERO-MUF, IN Mc, W ZONE, PREDICTED FOR JANUARY 1957

GPO 835191

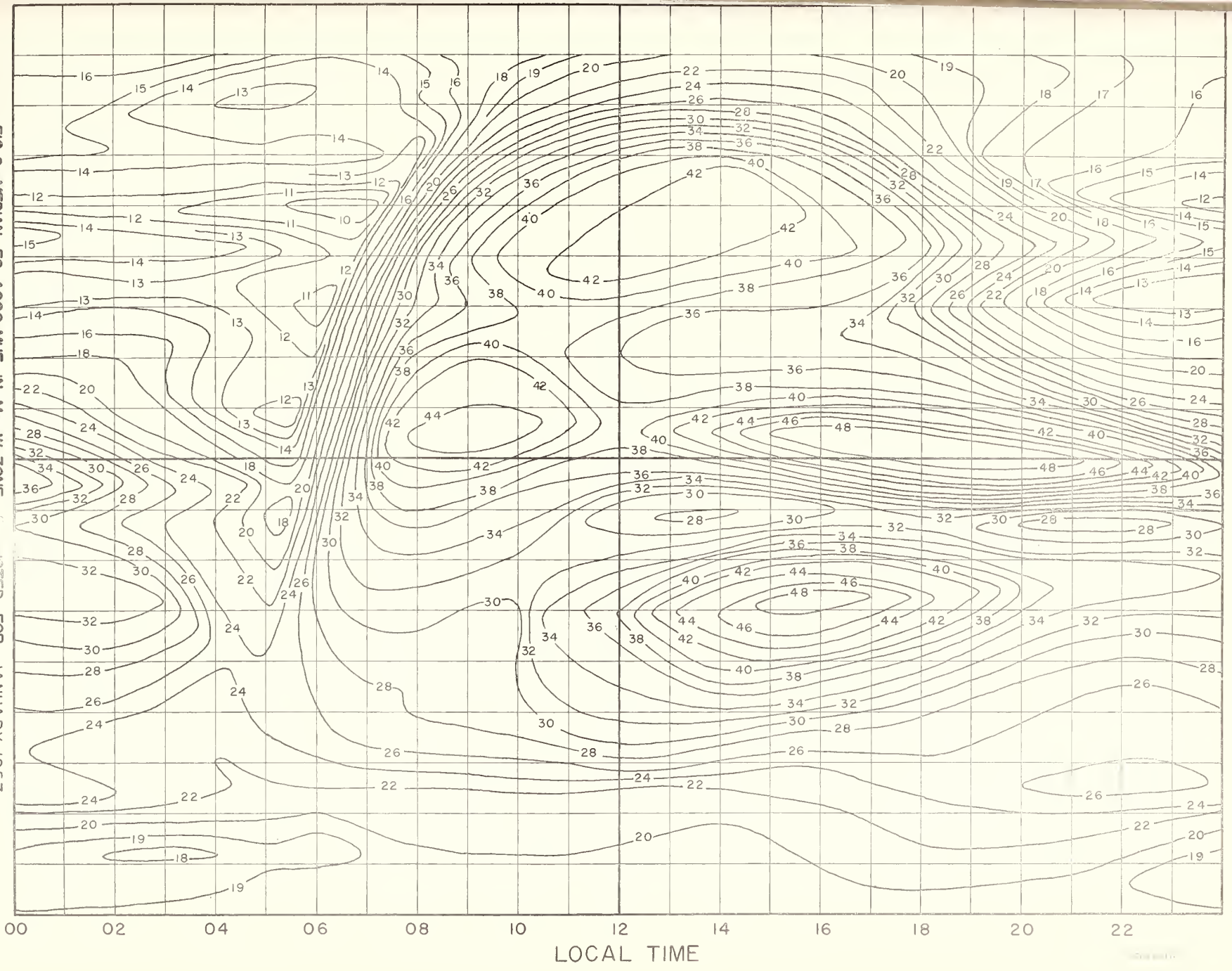


FIG. 2. MEDIAN F2-4000-MUF, IN Mc, W ZONE, [illegible] PLOTTED FOR JANUARY 1957

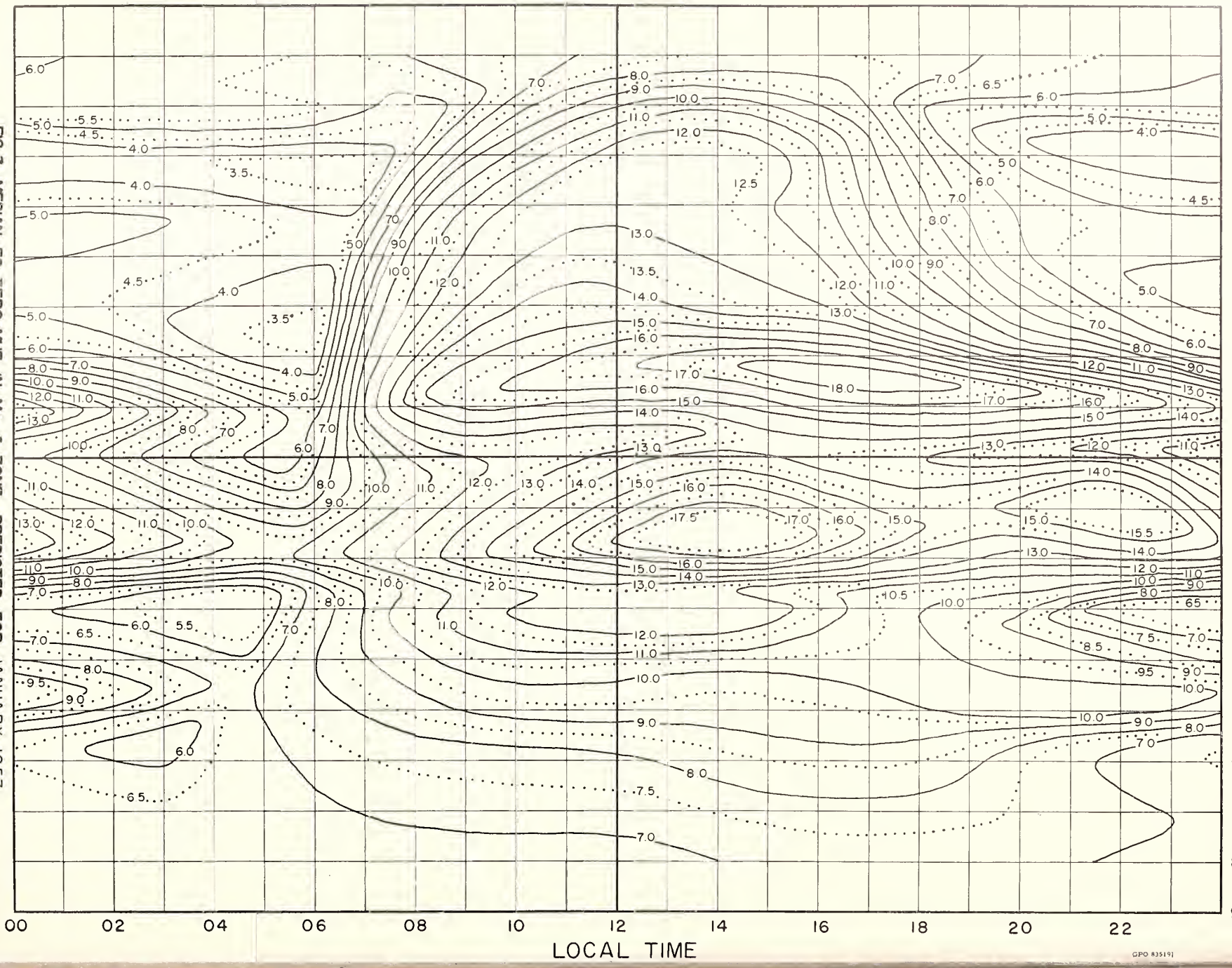


FIG. 3. MEDIAN F2-ZERO-MUF, IN Mc, I ZONE, PREDICTED FOR JANUARY 1957

GPO 835191

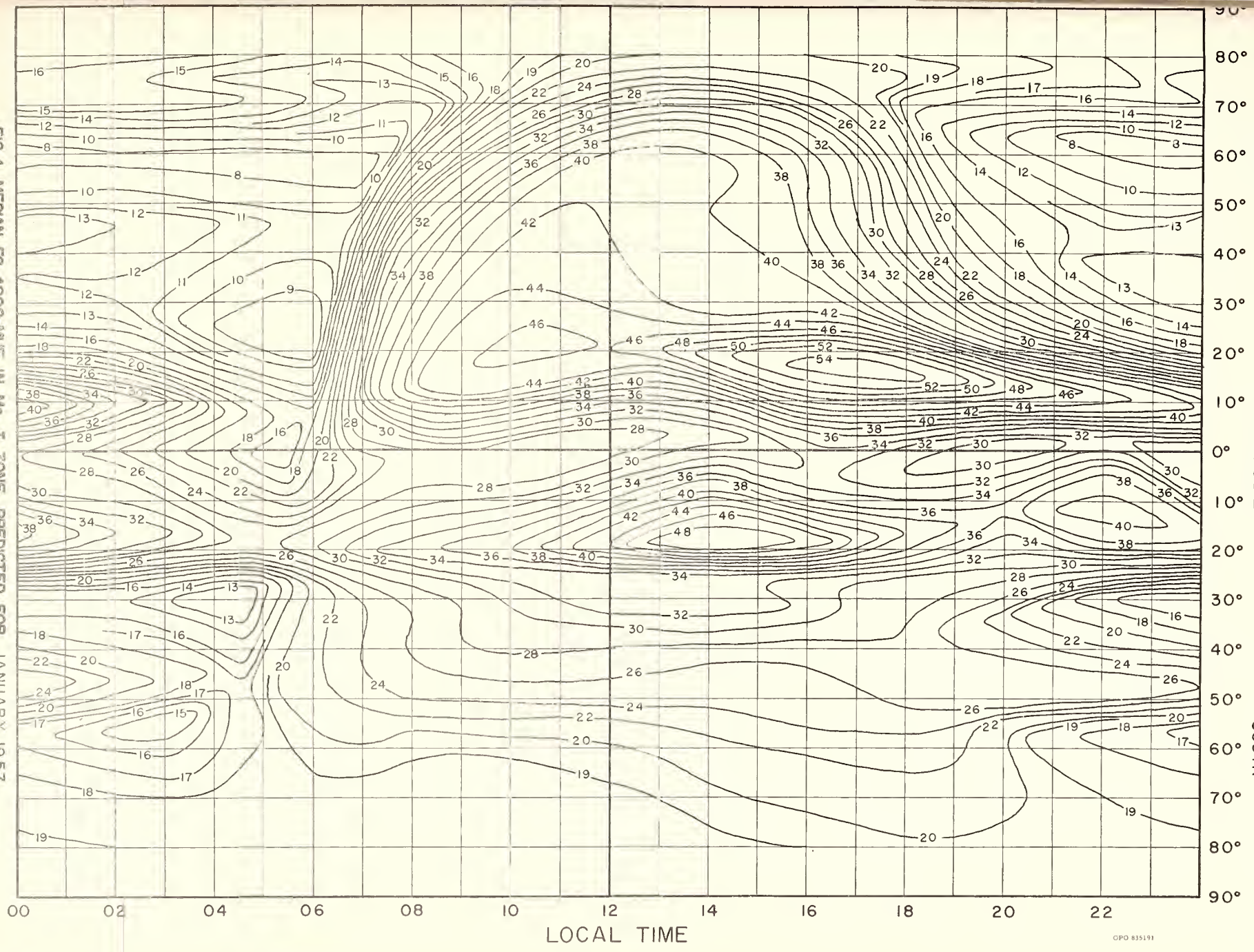


FIG. 4. MEDIAN F2-4000-MUF, IN Mc, I ZONE, PREDICTED FOR JANUARY 1957

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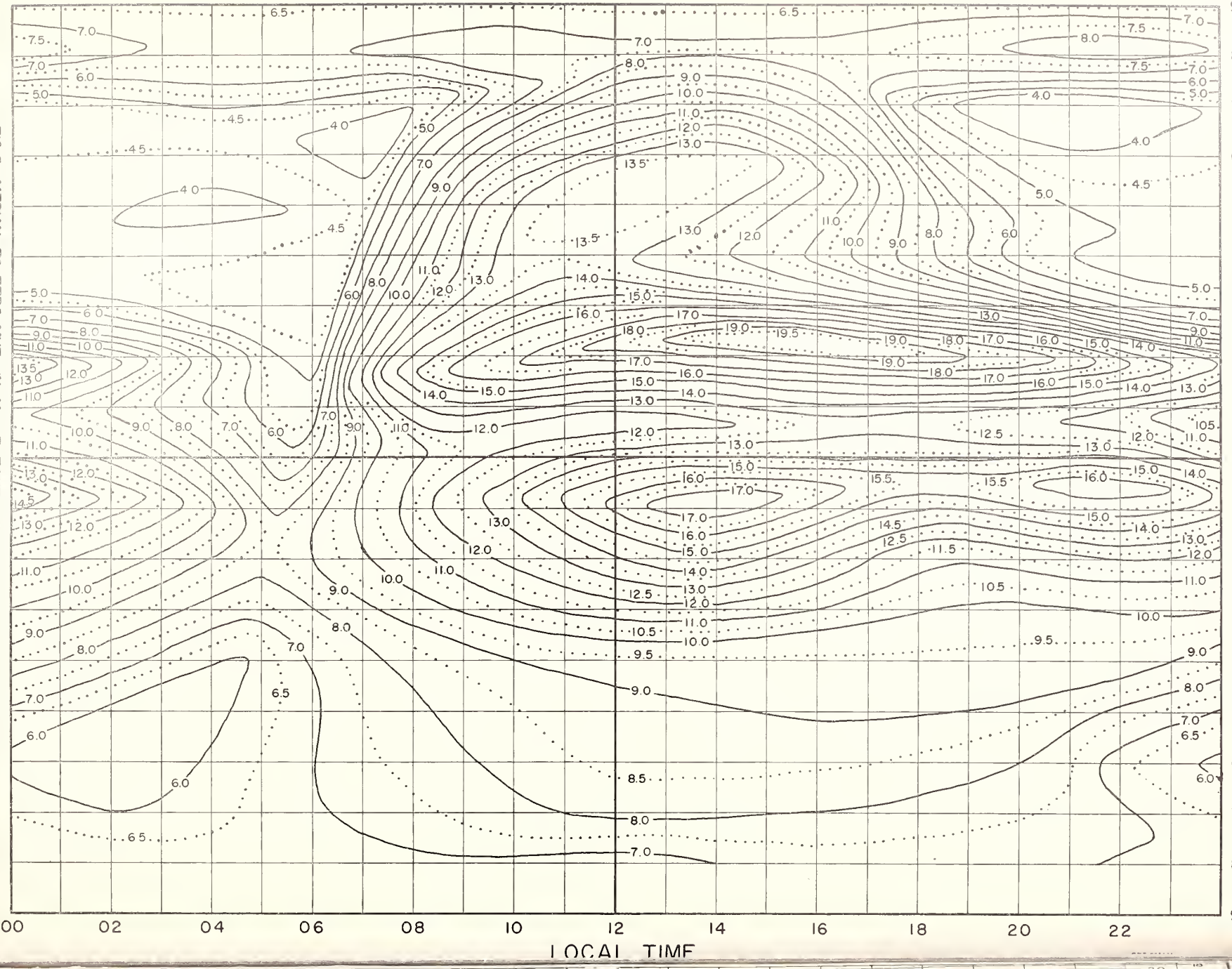


FIG. 5. MEDIAN F2-ZERO-MUF, IN Mc, E ZONE, PREDICTED FOR JANUARY 1957

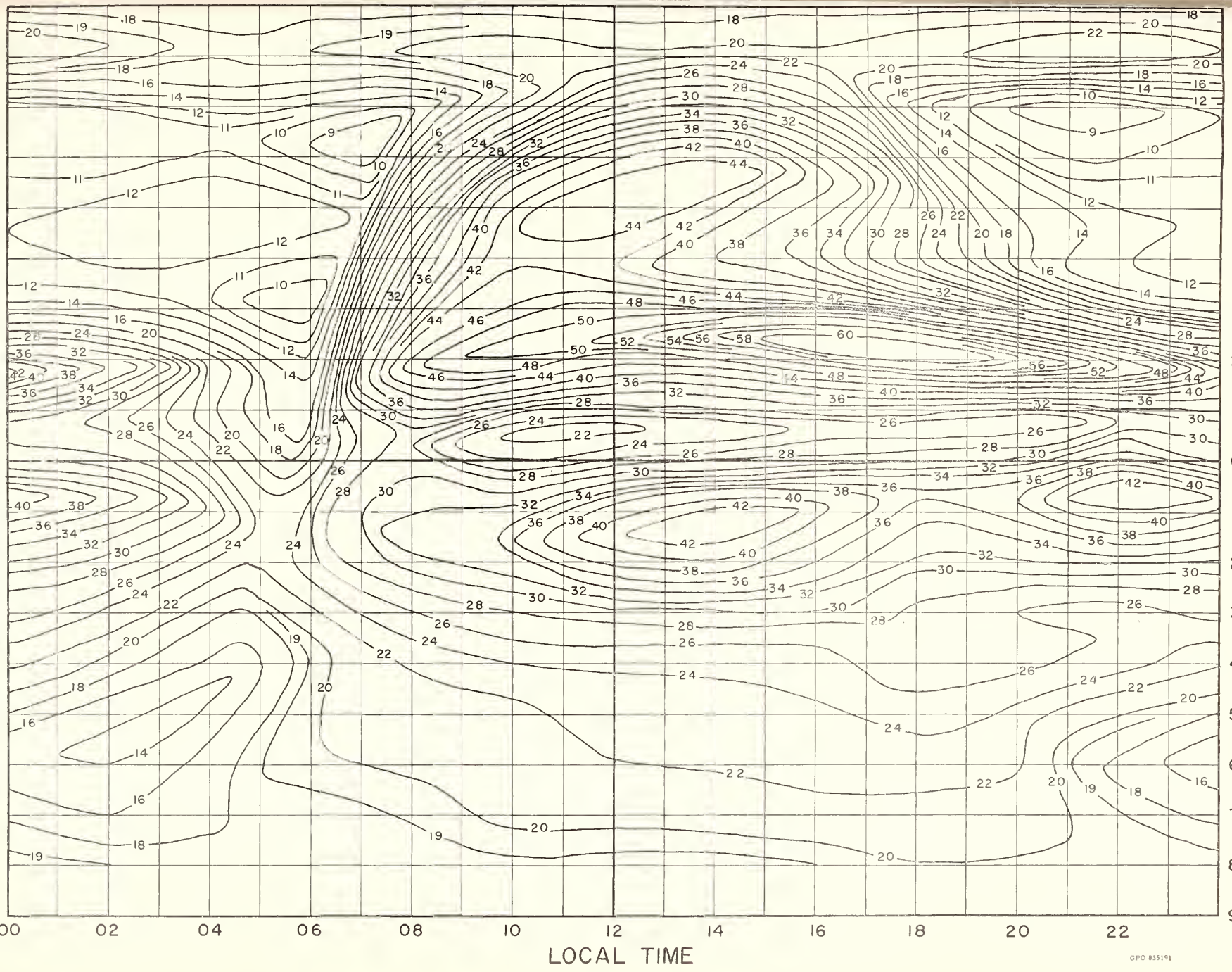


FIG. 6. MEDIAN F2-4000-MUF, IN Mc, E ZONE, PREDICTED FOR JANUARY 1957

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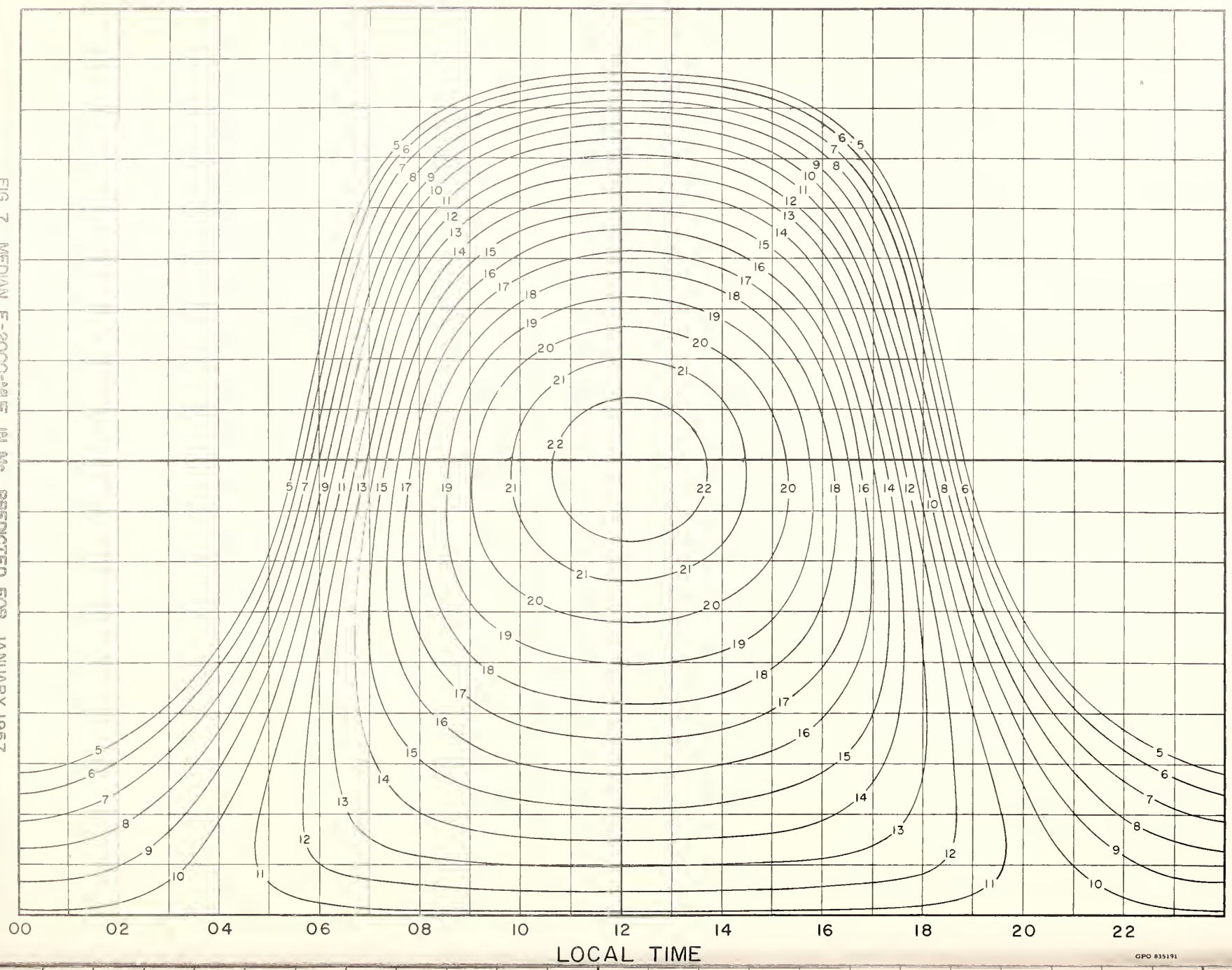


FIG. 7. MEDIAN E-2000-MUF, IN Mc, PREDICTED FOR JANUARY 1957

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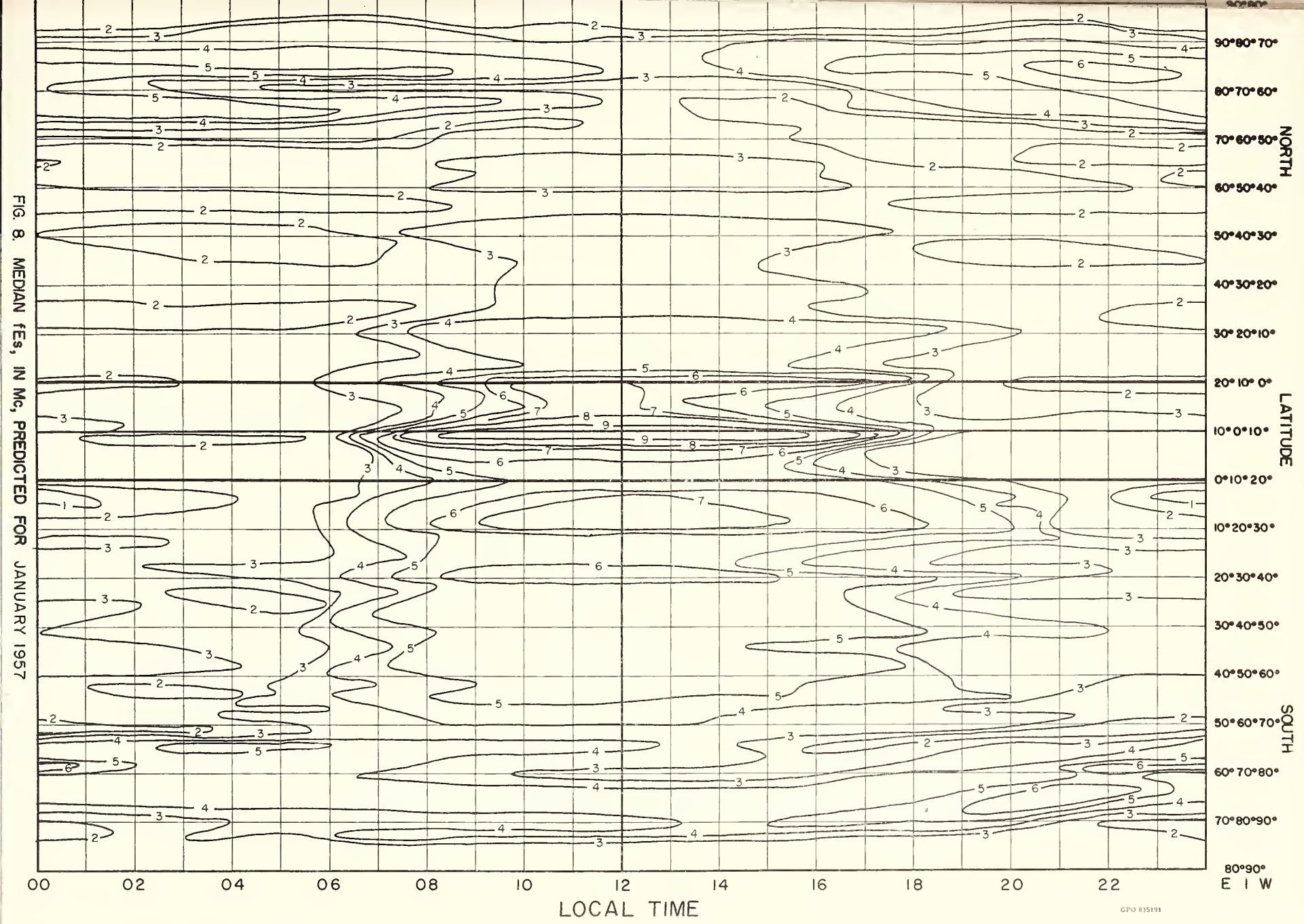


FIG. 8. MEDIAN fEs, IN Mc, PREDICTED FOR JANUARY 1957

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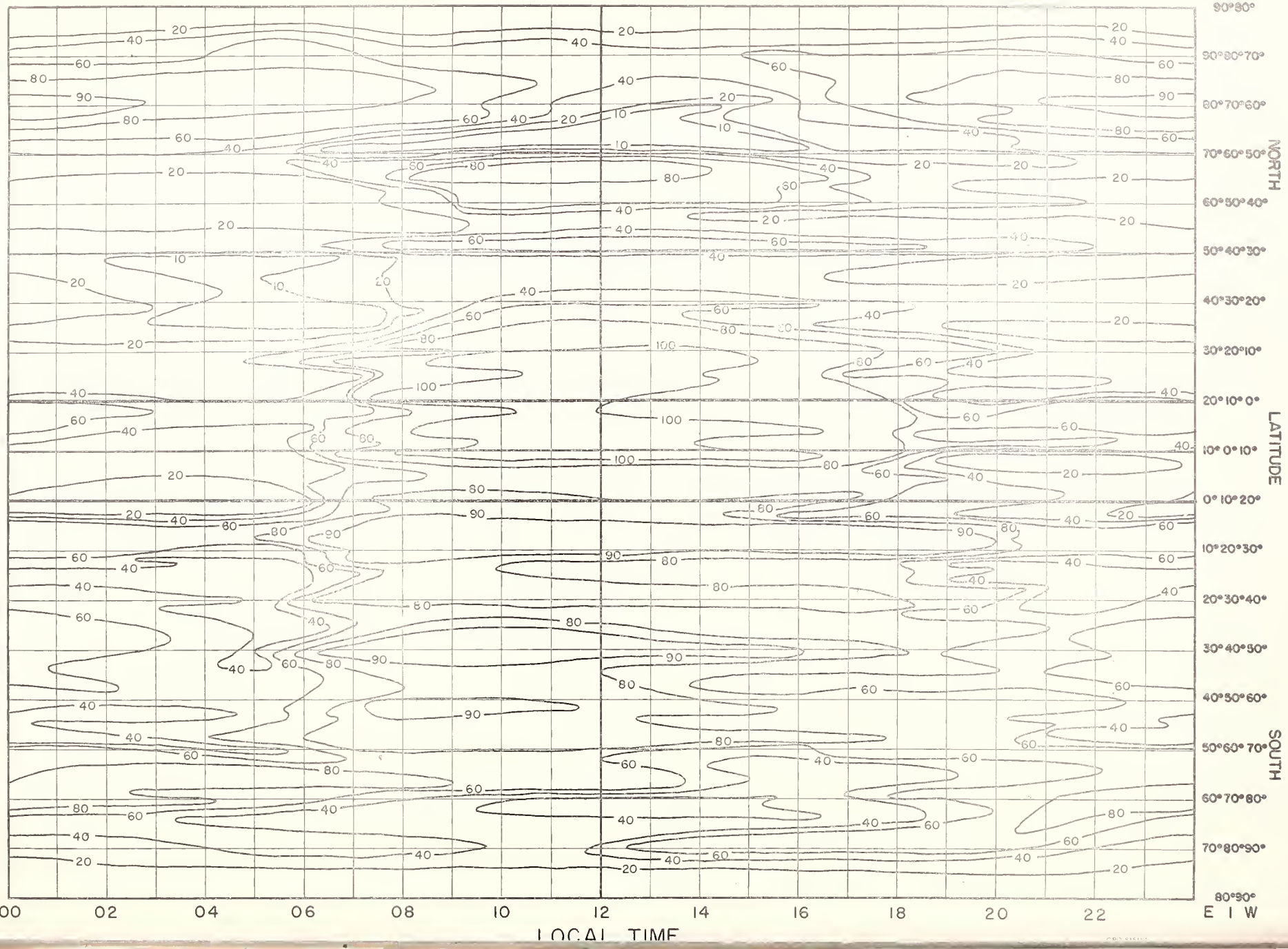
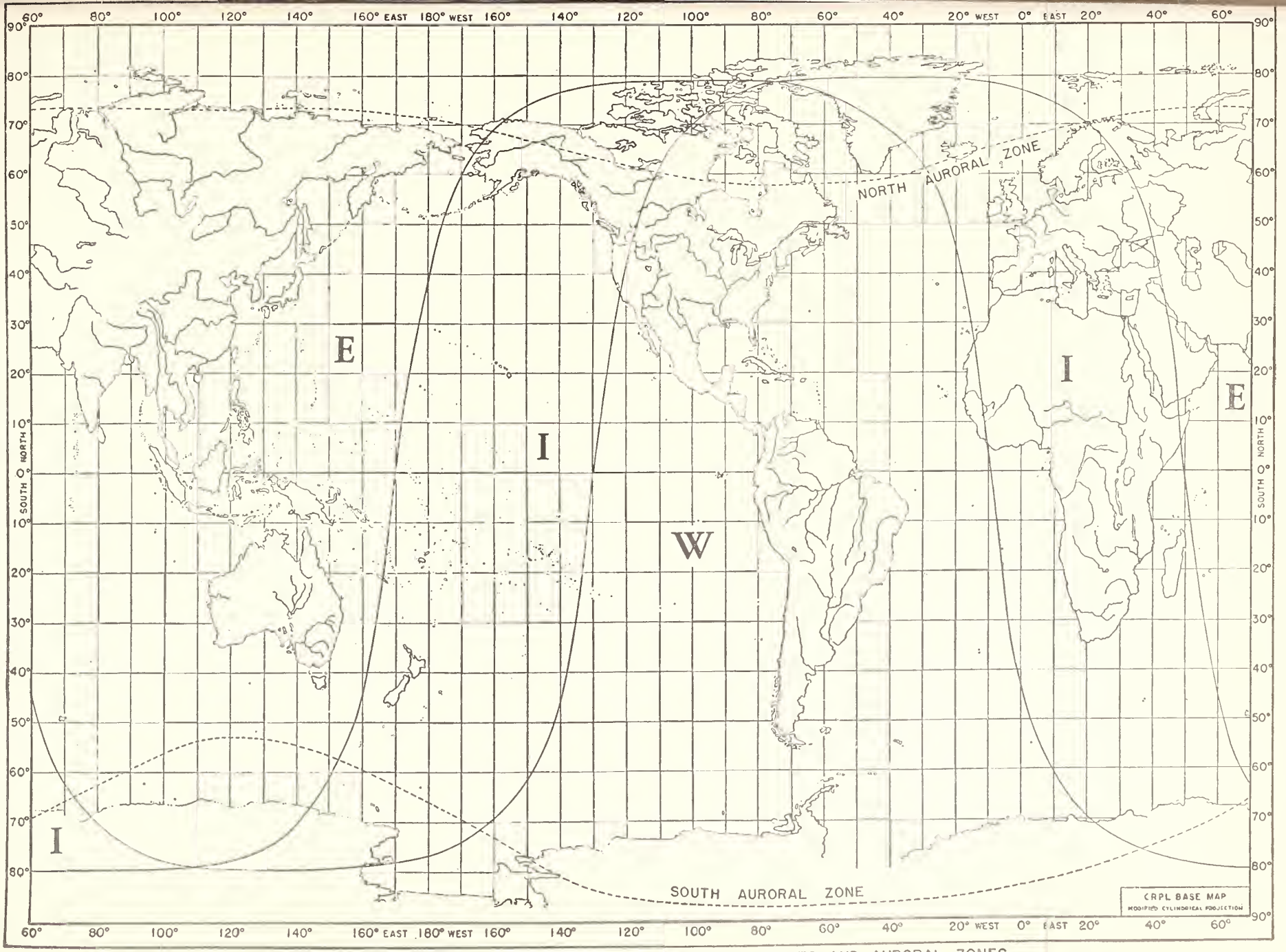
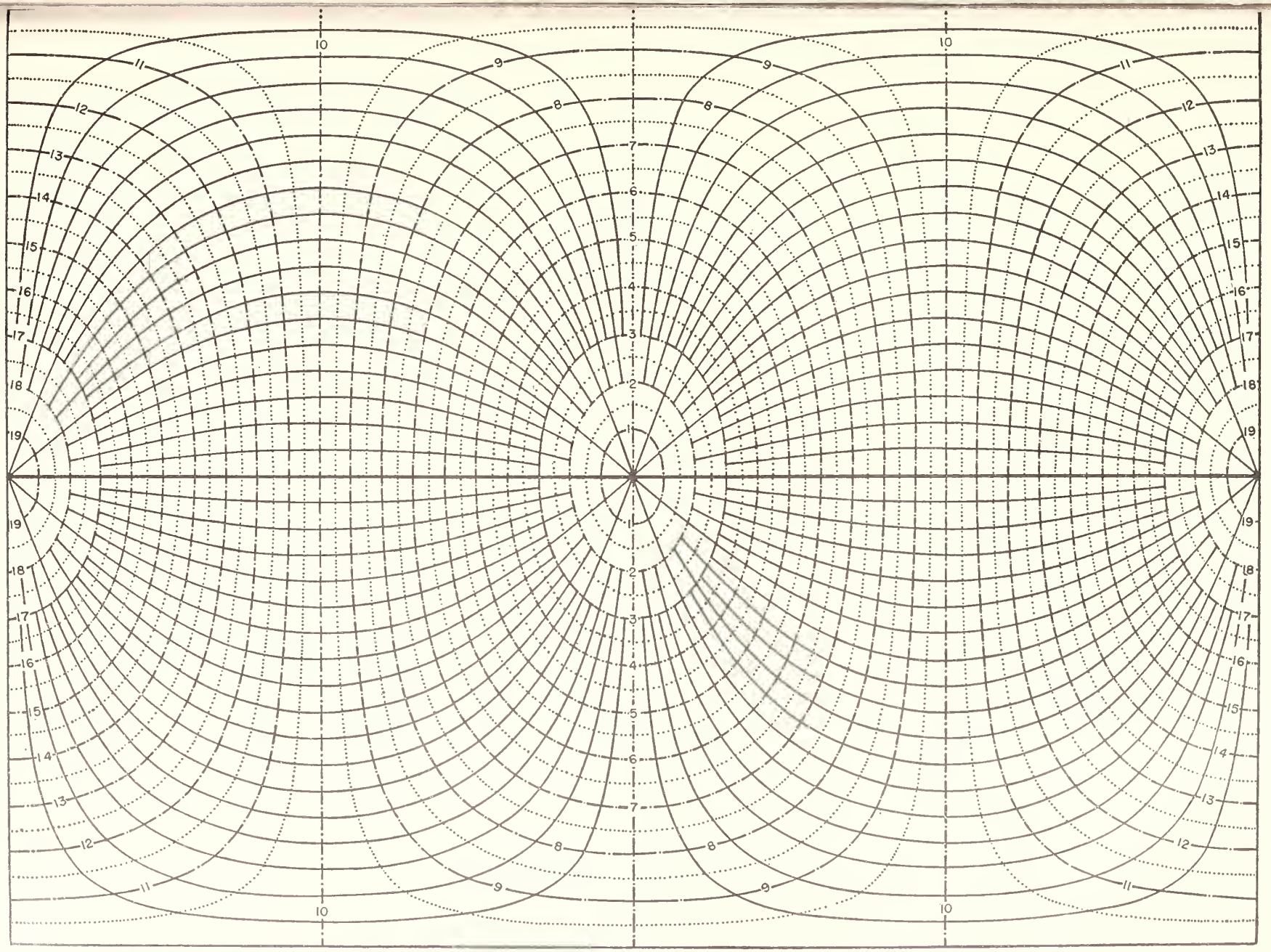


FIG. 9. PERCENTAGE OF TIME OCCURRENCE FOR Es-2000-MUF IN EXCESS OF 15 Mc, PREDICTED FOR JANUARY 1957



WORLD MAP SHOWING ZONES COVERED BY PREDICTED CHARTS, AND AURORAL ZONES.



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Form for Report to CRPL on Accuracy of Predictions

Name _____ Date _____

Address _____ _____ _____ _____ _____ _____
No. Street City P.O. Zone State Country

From (between) _____ to (and) _____ Date _____

Time (specify zone)																
Frequency Used																
D-Series Predicted FOT (OWF) Regular Layers																
D-Series Predicted FOT (OWF) Including Es																

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Daily:

Radio disturbance forecasts, every half hour from broadcast stations WWV and WWVH of the National Bureau of Standards.

Telephoned and telegraphed reports of ionospheric, solar, geomagnetic, and radio propagation data.

Semiweekly:

CRPL—J. North Atlantic Radio Propagation Forecast (of days most likely to be disturbed during following month).

CRPL—Jp. North Pacific Radio Propagation Forecast (of days most likely to be disturbed during following month).

Semimonthly:

CRPL—Ja. Semimonthly Frequency Revision Factors For CRPL Basic Radio Propagation Prediction Reports.

Monthly:

CRPL—D. Basic Radio Propagation Predictions—Three months in advance. (Dept. of the Army, TB 11–499–, monthly supplements to TM 11–499; Dept. of the Air Force, TO 31-3-28 series). On sale by Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Members of the Armed Forces should address cognizant military office.

CRPL—F. (Part A). Ionospheric Data.
(Part B). Solar-Geophysical Data.

Limited distribution. These publications are in general disseminated only to those individuals or scientific organizations which collaborate in the exchange of ionospheric, solar, geomagnetic or other radio propagation data or in exchange for copies of publications on radio, physics, and geophysics for the CRPL library.

Circulars of the National Bureau of Standards pertaining to Radio Sky Wave Transmission:

NBS Circular 462. Ionospheric Radio Propagation.

NBS Circular 465. Instructions for the Use of Basic Radio Propagation Predictions.

NBS Circular 557. Worldwide Radio Noise Levels Expected in the Frequency Band 10 Kilocycles to 100 Megacycles.

These circulars are on sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Members of the Armed Forces should address the respective military office having cognizance of radio wave propagation.

The publications listed above may be obtained without charge from the Central Radio Propagation Laboratory, unless otherwise indicated.

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